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ABSTRACT

This study compared two groups of high school biology students with respect to laboratory achievement, learning climate, and laboratory behavior on the part of both students and teachers. A cell physiology and nutrition unit containing ten exercises was utilized by five randomly assigned teachers (86 students) in an open-inductive method and by four randomly assigned teachers (90 students) in the conventional method. All teachers were experienced, given a special training session, and volunteered to participate. The adjusted trend analysis revealed some evidence that, after several experiments using the inductive method, the hypothesized curvilinear trend in achievement scores of the open-inductive group was equally as good or better than for the scores of the control group. The laboratory behavior of the two groups was significantly different on five of six comparisons as identified by an interaction analysis system developed by the author. Learning climate, indicated by using an instrument designed to measure the socio-emotional properties of the learning environment, was significantly different between the two groups. (Author/PR)

A Comparison of Two Methods of Managing Laboratory Experiments

by

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A paper presented at

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A Comparison of Two Methods of Managing Laboratory Experiments[1]

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This study compared two groups of high school biology students with respect to laboratory achievement, learning climate, and laboratory behavior on the part of both students and teachers. A cell physiology and nutrition unit containing ten exercises was utilized by five randomly assigned teachers (eighty-six students) in an open-inductive method and by four randomly assigned teachers (ninety students) in the conventional method. All teachers were experienced, given a special training session, and volunteered to participate.

A pretest of knowledge concerning cell physiology and cytology was given, and a brief quiz was administered following each exercise. The multivariate analysis of covariance test of equality of mean vectors resulted in a significant difference between the experimental and control groups.

Trend analyses were conducted both by order of administration and by sequence number with and without the pretest covariate. In all trend analyses there were significantly different linear and quadratic components to the set of means. The two groups also differed significantly on the linear interaction component, but there were no significant differences on the quadratic interaction component. The hypothesis that achievement would improve over the span of ten exercises, and that an open-inductive method would result in higher achievement scores was not supported. However, the adjusted trend

[1]The major part of this presentation has been submitted to the American Educational Research Journal for Publication.

analysis revealed some evidence that after several experiments using the inductive method, the hypothesized curvilinear trend in achievement scores of the open-inductive group were equally as good or better than the scores of the control group.

Classroom behavior was obtained by means of an interaction analysis category system developed by the author and collected by trained but "blind" observers. This data was separated into three categories: teacher - pupil interaction data, student data, and teacher data. Kolmogorov-Smirnov tests following Markov chain analysis revealed that the laboratory behavior of the two groups was significantly different on five of six comparisons.

The teachers using the open-inductive method were more indirect, while the control group teachers used more direct means of managing the laboratory activities demonstrating the construct validity of the category system. Student behavior was significantly more dependent in the control classes.

Classroom climate was assessed with an instrument designed to measure the socio-emotional properties of the learning environment. A multivariate one-way analysis of variance upheld the author's expectations of significant differences between groups.

The use of an open-inductive method yielded significantly different results for classroom behavior, for learning environment and for achievement. Taken together these results indicate that a teacher who hopes to foster greater independence in his science students may try using laboratory activities which are written as an open-inductive investigation. He

should also use behavior which is indirect, and supervision which is passive during the activity portion of the lab. His basic criterion should not be improved achievement since this may actually be lowered initially, although with practice it might be equal to or possibly surpass the achievement of students who had been in laboratories which were traditionally managed.

TABLE 1

The Egelston Category System

Teacher-Indirect

1. Praises, jokes, accepts feelings
2. Uses or corrects students' responses, work
3. Asks questions
4. Oversees or passively supervises students at work

Teacher-Direct

5. Reprimands, shouts, uses sarcasm
6. Demonstrates technique, process
7. Lectures
8. Gives directions
9. Actively looks at students' work

Pupil-Independent

10. Looks up information
11. Manipulates equipment, writes
12. Initiates, volunteers, questions
13. Gives information or assistance to other students

Pupil-Dependent

14. Response to teacher's question
15. Seeks assistance
16. Receives assistance

Other

17. Unclassifiable behavior or confusion

Table 2

Adjusted Means and F ratios for Experimental and Control Groups on Pretest and Lab Quizzes

		Quiz Order								
Group	Pretest	1	2	3	4	5	6	7	8	9	10
Exper.	29.8	58.5	54.2	67.3	58.2	66.8	60.9	65.5	59.1	61.4	53.6
Control	36.5	66.2	66.0	65.9	61.6	69.5	56.5	58.5	61.7	52.8	52.4
F[a]	----	3.65	8.51*	.14	.36	.62	1.34	2.43	.53	4.46*	.08

[a] df = 1,114

* p<.05

TABLE 3

Trend Analysis for Experimental and Control Groups on Ten Achievement Quizzes in Order of Administration Without Covariate

Source	df	Mean Square	F
Linear Trend	1	14715.57	30.72*
Linear Interaction	1	2666.50	5.57*
Quadratic Trend	1	4548.03	9.49*
Quadratic Interaction	1	600.46	1.25
Error	1692	479.02	

*$p < .05$

TABLE 4

Means and Standard Deviations for Experimental and Control Groups and Univariate F Values on Each If 14 Scales of the Learning Environment Inventory

Group	Scales [1]													
	1	2	3	4	5	6	7	8	9	10	11	12	13	4
Experimental														
mean	2.05	2.44	2.47	2.69	2.73	2.71	2.43	2.62	2.41	2.66	2.49	2.45	2.49	2.34
S	.43	.33	.27	.32	.34	.27	.29	.27	.36	.33	.31	.34	.31	.29
Control														
mean	2.15	2.47	2.43	2.53	2.67	2.58	2.61	2.66	2.45	2.45	2.54	2.33	2.60	2.30
S	.30	.32	.32	.35	.38	.31	.30	.35	.31	.43	.32	.39	.32	.26
F value [2]	5.93*	.39	.99	10.23*	1.10	8.91*	15.98*	.68	.71	12.23*	.79	4.61*	5.13*	.88

[1] Scale names: 1 - Intimacy, 2 - Friction, 3 - Cliqueness, 4 - Apathy, 5 - Favoritism, 6 - Formality, 7 - Satisfaction, 8 - Speed, 9 - Difficulty, 10 - Goal Direction, 11 - Democratic, 12 - Disorganization, 13 - Diversity, 14 - Environment

[2] $d_f = 1,168$

* $p < .05$

TABLE 5

Cumulative Proportion Vectors for Teacher-pupil Interaction[a]

Group	1-4	5-9	10-13	14-16	17	χ^2
Experimental	.145	.855	.879	.936	1.000	48.05*
Control	.069	.857	.901	.944	1.000	

[a]Sample sizes were 5320 and 3264 for the experimental and control groups, respectively.

*$p < .05$

TABLE 6

Cumulative Proportion Vectors For Pooled Teacher Behavior[a]

Group	2-3	4	5-8	9	17	χ^2
Experimental	.007	.649	.680	.961	1.000	292.28*
Control	.003	.276	.339	.960	1.000	

[a]Sample sizes were 1216 and 926 for the experimental and control groups, respectively.

*$p < .05$

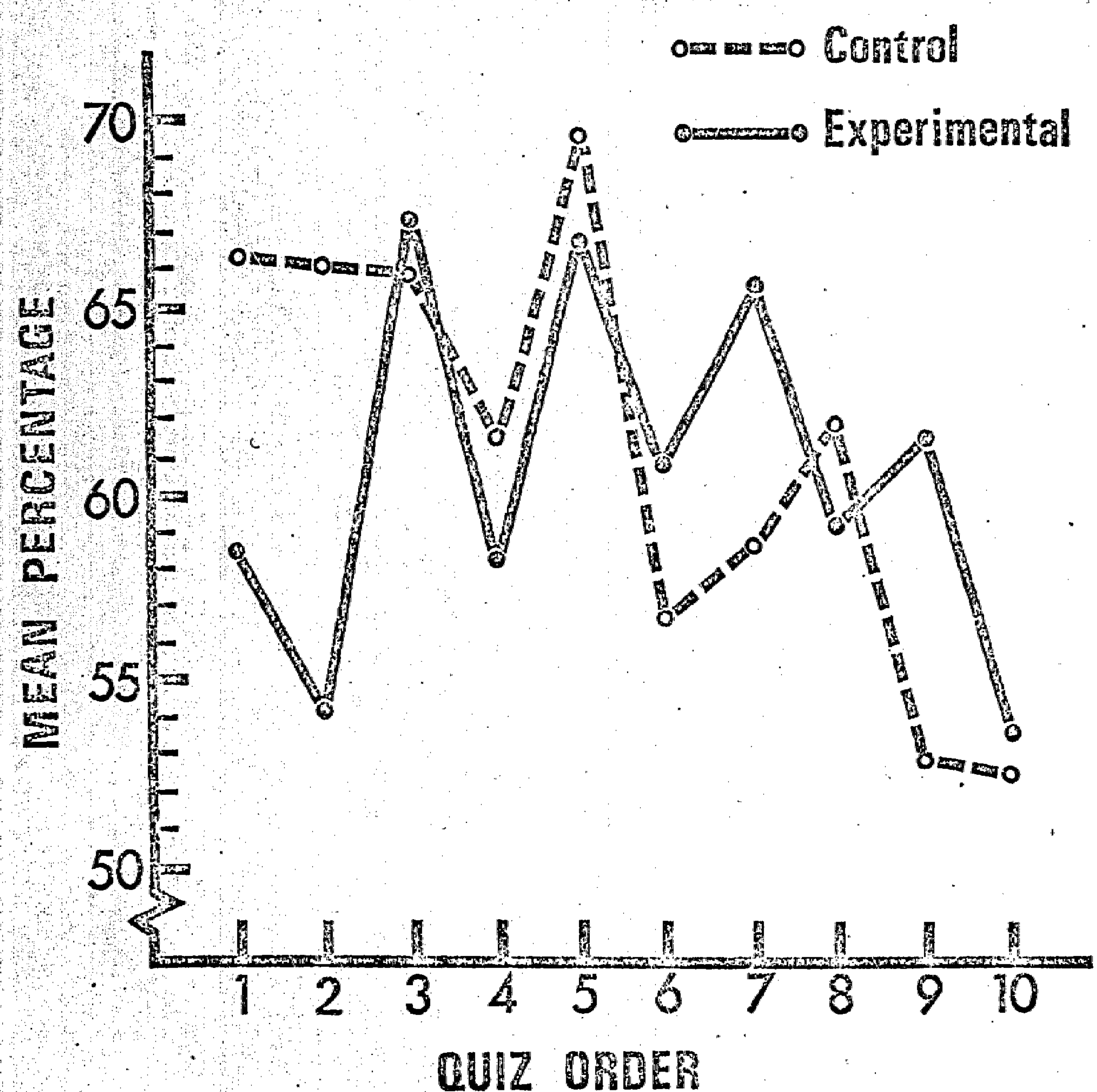
TABLE 7

Cumulative Proportion Vectors For Pooled Pupil Behavior[a]

Group	10-13	14-16	17	x^2
Experimental	.889	.952	1.000	126.61*
Control	.833	.909	1.000	

[a]Sample sizes were 23512 and 17706 for the experimental and control groups, respectively.

*$p < .05$


Control
Experimental
70
65
60
55
50
MEAN PERCENTAGE
1
2
3
4
5
6
7
8
9
10
QUIZ ORDER